6.12 AMBER, Astronomical Multi-BEam combineR

AMBER is a near-infrared, multi-beam interferometric instrument, combining up to 3 telescopes simultaneously. In Period 91, AMBER can be used with UTs or ATs. For specifications of the UT and AT performances see Section 4.2.2 and Section 4.2.4. All possible triplets of UTs are available, and a number of selected AT combinations. For the telescope positions and baseline lengths of the different AT and UT baselines, please refer to **the VLTI baseline page**.

Because of the limited availability of UTs for AMBER, any scientific programme on the UTs should be designed so that scientifically meaningful results can be achieved in a single night.

Important note: In addition, in order to allow for the installation of the Deformable Secondary Mirror, UT4 will not be available during part of Period 92. Large Programmes using UT4 with AMBER should take this limited availability of UT4 into account.

6.12.1 Spectral Modes and Coverage

The following spectral modes are offered: the Low Resolution H+K bands (LR-HK), Medium Resolution K band (MR-K), High Resolution K band (HR-K) and Medium Resolution H Band (MR-H). For central wavelengths and wavelength coverages for LR-HK, MR-K, MR-H and HR-K see **the AMBER web page.**

6.12.2 Integration times, DIT

External fringe tracking with FINITO is available on both the UTs and the ATs. The use of FINITO allows the entire AMBER detector to be read, maximizing simultaneous spectral coverage. It also allows the AMBER DITs to be adjusted to yield sufficient signal-to-noise ratio per frame in the fringes. However, the DIT has to remain small since, even with the help of the fringe tracker, interferometric fringes get significantly blurred after integrations lasting seconds. Note that medium and high resolution are only offered with external fringe-tracking as standard setup.

If no fringe tracker is used (*i.e.* faint and/or extended objects, or airmass too high) the integration times with AMBER will have to be short to minimise the blurring caused by the atmospheric turbulence. In Low Resolution, without external fringe tracking, the maximum authorized DITs are set to 100ms on the ATs and 50ms on the UTs. If *absolute visibility* measurements is the goal, the shortest authorized DITs are recommended (see Table 2 in the Template manual); if *closure-phase* and *wavelength differential-mode* are the quantities of interest, the maximum recommended DIT should be used.

As of Period 91 it will be possible (only in visitor mode) to operate AMBER in self-coherencing mode which significantly improves the quality of data when FINITO cannot be used for fringe tracking. Check the **AMBER Users' Manual** for details.

Special Modes: Special Programmes may require a different combination of modes and DITs. This is the case when using MR or HR without external fringe-tracking. A shorter DIT strongly reduces the limiting magnitude. It also reduces the spectral coverage that can be read. Any proposal requiring a non-standard DIT should carefully detail the justification and the technical feasibility. It will be scheduled in Visitor Mode.

In Service Mode the AMBER DITs ought to be chosen while preparing the Phase II. The AMBER template manual, available on the **AMBER documentation page**, provides the recommended DITs for all offered configurations.

6.12.3 Limiting magnitudes

AMBER and the VLTI have limitations in magnitude (V-band, H-band and K-band), fringe contrast (H-band and K-band), airmass and seeing. The details of these limitations can be found on the

AMBER web page:, as well as the most updated values on visibility accuracy and closure phase accuracy.

The limiting magnitudes are estimates on the basis of at least 50% of the frames being successfully processed by the AMBER pipeline. If a lower yield rate is accepted, an increase of up to 0.5 in the limiting magnitude can be achieved. In this case, the user should account for additional integration in the same spectral band (Section 6.12.5) to obtain more frames.

The limiting correlated magnitude depends on the AMBER spectral resolution, the FINITO tracking mode (No-Tracking, Group-Tracking or Fringe-Tracking), and the seeing conditions. The main interest of FINITO Group-Tracking at faint magnitudes is to enhance the SNR on the AMBER closure-phase, but reducing the flux in the H-band.

In order to be observable with FINITO, the target should have:

H magnitude:	-2 to 5 (ATs)	1 to 7 (UTs)
Visibility in H:	$> 15\%$ (ATs)	$>10\%$ (UTs)

6.12.4 Calibration strategies

AMBER requires frequent calibration on-sky, using calibrator stars. We offer two calibration modes: "CAL-SCI-CAL" and "CAL-SCI". The first one is the standard mode which should be used in most cases, in particular when *absolute calibration* is required for best accuracy. Absolute calibration is required in most programmes, but for some programmes *wavelength differential quantities* provide the astrophysical information. In that case, "CAL-SCI" (or indifferently "SCI-CAL") is sufficient.

The choice of on-sky calibration strategy should be specified in the "calibration request" section of the proposal. **The strategy will be reviewed particularly carefully during the technical feasibility. Proper justification must be provided if "CAL-SCI" is requested instead of the standard "CAL-SCI-CAL".**

6.12.5 Execution times

For each Observing Block (OB), either SCI or CAL the proposer(s) should consider the following:

- Acquisition requires 10min in HR or MR, 5 minutes in LR, including the spectrograph setup and the recording of the calibration fringes (so called P2VM). See Table 16 for more details.
- Integration requires 15min. A maximum of 3 integrations is allowed per OB, which could consist in repeating 3 times the same integration or 3 integrations around 3 different central wavelengths *within the same spectral setup*.

Hence a normal "CAL-SCI-CAL" sequence requires 75min in MR or HR and 60min in LR.

When observing targets close to the limiting magnitude in MR or HR, it is recommended to double or triple the integration, and to focus on *wavelength differential quantities*. Hence a "SCI-CAL" sequence with triple integration requires 2×1h=2h.

Using a non-standard DIT (below 200ms in MR and HR, or below 25ms in LR, see Section 6.12.2) can strongly reduce the spectral coverage available within one integration. To obtain measurements at different position within the range of the spectrograph setup, the user can use 2 or 3 integrations with different central wavelengths.

6.13 VIRCAM, VISTA InfraRed CAMera

VISTA (Section 4.2.5) is equipped with the near infrared camera VISTA InfraRed CAMera (VIRCAM), which covers a 1.65 degree diameter field of view with a loosely packed detector mosaic totalling $\approx$ 67 million pixels of mean size $0.339''$. The point spread function (PSF) of the telescope+camera system including pixels is measured to have a FHWM of $0.51''$.

Further information on this instrument can be found on the **VISTA web page**.